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LIFE HISTORY AND CONTROL OF THE ASIATIC GARDEN BEETLE

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INTRODUCTION

In the summer of 1921 specimens of a scarabaeid beetle were collected in a nursery near Rutherford, N. J. (*10*).[2] Although this insect increased in numbers and became increasingly destructive in New Jersey and in New York, it was not until 1926 that it was determined as a foreign insect, *Autoserica castanea* Arrow (*9*). The insect's native habitat has been recorded as Japan and China, but it has never been mentioned as economically important in these countries. In the United States the insect soon became known as the Asiatic garden beetle. Many reports of injury caused by this pest and inquiries as to how it could be controlled were received in 1928, but only a comparatively small number in 1929 and 1930, a consequence of the decrease in the insect occasioned by the summer droughts in these two years. In 1931, however, with the return of more nearly normal conditions of rainfall, more complaints of injury caused by the pest were received than during all of the preceding four years.

This circular presents information concerning the stages of this insect, its distribution, life history, and habits, the nature of the damage caused by the larvae and adults, and the control measures that have been found effective.

DISTRIBUTION

The spread of the insect in the United States has not been rapid, but it is now known to occur in a number of widely separated localities in Connecticut (*3*), Delaware, the District of Columbia, Maryland, New Jersey (*10*), New York (*5, 7*), Pennsylvania, and Virginia. (Fig. 1.) The areas of dense infestation, in which extensive defoliation of ornamental garden plants has resulted from the feeding of the adult beetles and in which lawns have been frequently ruined through the attacks of the larvae, are distributed in New York State as follows: Nassau County, northern half, south to Jericho, Westbury, Garden City, and Floral Park; Queens County, vicinity of Douglaston, Flushing, Kew Gardens, Little Neck, and Queens Village; Bronx County, at Bronx Botanical Gardens and Woodlawn; Westchester County, southern part, north to a line indicated by the location of Mamaroneck, Scarsdale, and Dobbs Ferry. In New Jersey heavy infestation is general in an area in the northeastern part of the State extending from the Hudson River west to such places as Hackensack, Bergen County, Paterson, Passaic County, and Summit, Springfield, and Elizabeth, Union County. The isolated infestations at Philadelphia and Harrisburg in Pennsylvania, as also that at Washington, D. C., are only moderately heavy and, in severity and extent of damage produced, fall very far below that witnessed in Nassau and Queens Counties in New York. In the remaining areas of infestation shown on the map (fig. 1) the presence of the Asiatic garden beetle would only rarely be apparent to a casual observer. Of these

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[1] The original drawing of the anal plate (fig. 3) was made by R. J. Sim, of the Japanese beetle laboratory, Moorestown, N. J. The photographic work, done by R. L. Coffin, formerly connected with the Japanese beetle laboratory, is also gratefully acknowledged.
[2] Italic numbers in parentheses refer to Literature Cited, p. 16.

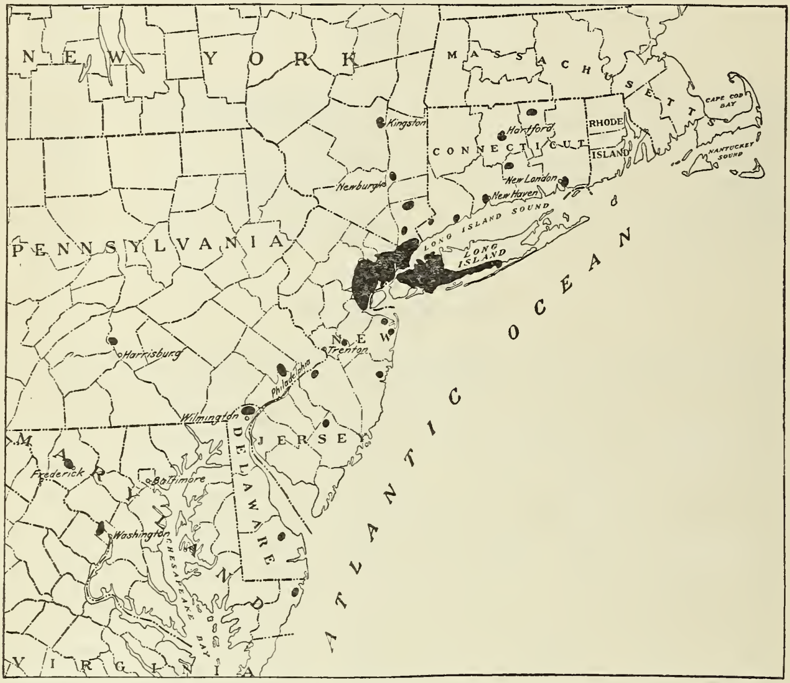

FIGURE 1.—Distribution of the Asiatic garden beetle in the United States indicated by black areas

relatively light infestations the most northern are found at Kingston, N. Y., Mansfield and Manchester, Conn., and the most southern at East Falls Church, Va.

DESCRIPTION OF STAGES

THE EGG

The eggs of the Asiatic garden beetle are white, ovoid, and about 1 millimeter in diameter. They are laid in clusters (fig. 2) ranging up to 19, loosely held together by a gelatinous material. After being in the soil a few days, the egg increases in size and becomes nearly spherical in shape. When the time for hatching approaches, the egg clusters fall apart readily when disturbed.

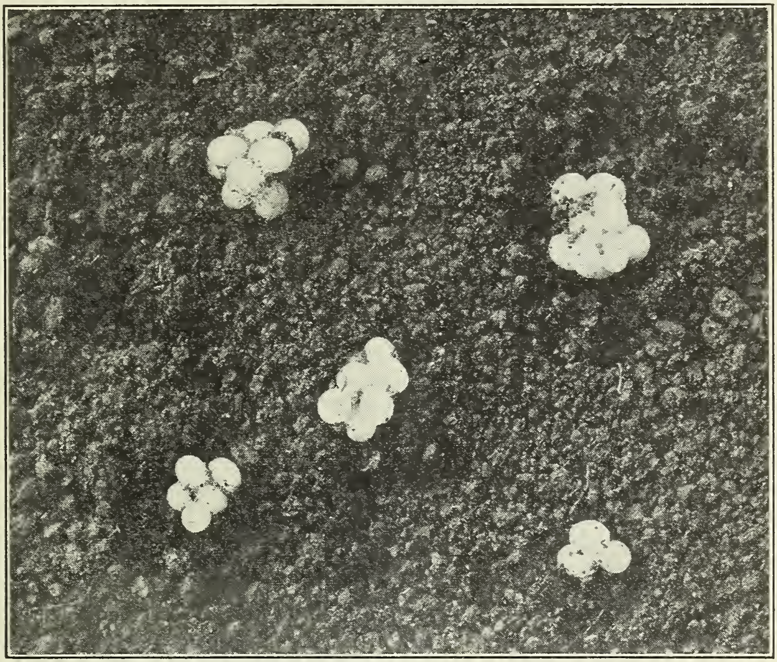

FIGURE 2.—Egg clusters of the Asiatic garden beetle. ×3

THE LARVA

When first hatched, the larva measures about 1.4 millimeters, or one-eighteenth inch, in length. At this time it is white, except for the tips of the mandibles, the egg burster, and some of the setae, which are brown. The head soon changes to a light-brown color and the body darkens slightly, owing to the filling of the intestine after feeding begins. The body always remains lighter in color than that of most scarabaeid larvae. There are three larval instars, and after each molt the usually light-brown portion of the body becomes white again until its chitinous parts have hardened. These larvae resemble the larvae of May beetles, commonly called white grubs, but are much smaller. The anal opening is Y-shaped, and there is a single transverse curved row of spines on the underside of the last segment (fig. 3), whereas in the white grubs of May beetles the anal opening is V-shaped or Y-shaped and there are two longitudinal rows of spines. When the grubs become fully grown they are approximately three-fourths inch in length. (Fig. 4.)

When the larva reaches maturity it prepares an earthern cell, in which it pupates. The cell is made by the movements of the larva, and the soil is gradually packed until a smooth cavity is formed of sufficient size to provide for the activities necessary for pupation and emergence. The larva then ceases to feed and ejects the accumulated excrement, the legs cease to function and become shriveled, and the color of the body changes to a yellowish white. In this condition the larva is termed a prepupa.

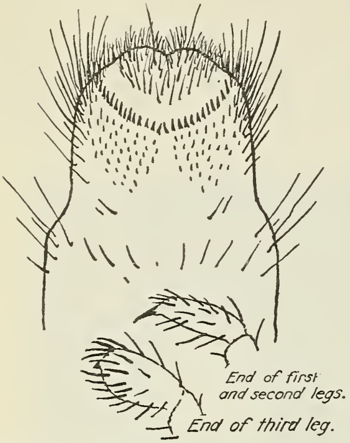

FIGURE 3.—Asiatic garden beetle: Ventral view of larval pygidium, showing distinguishing hairs, and tips of legs, showing the claw character

THE PUPA

The movement of the developing pupa (fig. 5) within the larval skin causes the latter to split, exposing the pupa, which is at first pure white, but gradually becomes a tan color as the body wall becomes tougher. The pupa soon pushes the cast larval skin back beyond the tip of the abdomen and thus lies completely uncovered in its earthen cell, which is in marked contrast to the pupae of many other scarabaeid beetles which continue to remain inclosed in the dried and split larval skin for some time after the molt.

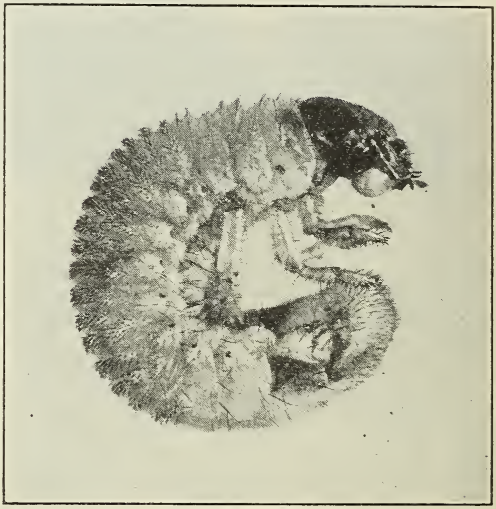

FIGURE 4.—Larva of the Asiatic garden beetle. ×8

THE ADULT

In 1913 Arrow described *Autoserica castanea* from specimens taken in Japan (*2*). The adult beetle (fig. 6) is chestnut brown in color, and has a velvety appearance which is due to the opacity of the surface. The elytra do not entirely cover the abdomen, the last two segments being almost entirely exposed. The under surface of the abdomen has on each segment a row of short yellowish hairs, and the underside of the thorax is also partly covered with yellow hairs. On the upper surface of the body hairs are present only on the outer margins of the elytra, on the lateral and sometimes the anterior margins of the prothorax, and on the forehead. These small erect hairs on the head are of considerable value in recognizing the species. The insect varies in length from five-sixteenths to seven-sixteenths inch, and in width from three-sixteenths to one-fourth inch.

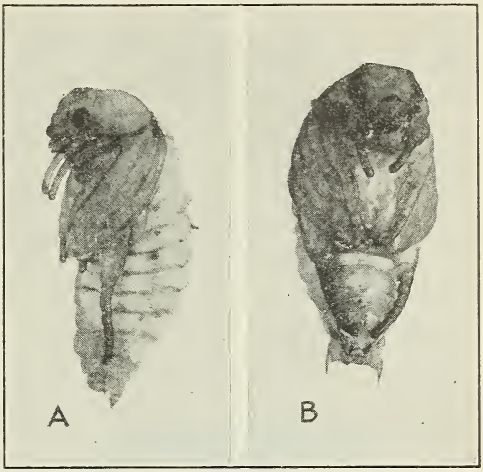

FIGURE 5.—Pupa of the Asiatic garden beetle: A, Lateral view; B, ventral view. ×5

LIFE HISTORY

In the latitude of New York City the life cycle of the Asiatic garden beetle is completed in one year. The adults begin to appear during the last week of June[3] and may be found from then until the end of October. They are most abundant from July 15 to August 15. (Fig. 7.) The average length of adult life is about a month, although in cages a few individuals have lived as long as 106 days.

The females burrow into the soil to oviposit, and egg laying is continued at irregular intervals from early in July until late October. Eggs are found in the ground at depths varying from one-half inch to 4 inches, but occur mostly within an inch or two of the surface. In cages as many as 178 eggs have been deposited by a single beetle, but the average is only about 60. The eggs hatch ordinarily in about 10 days, and in the field they have been found from July 3 to October 23. (Fig. 7.)

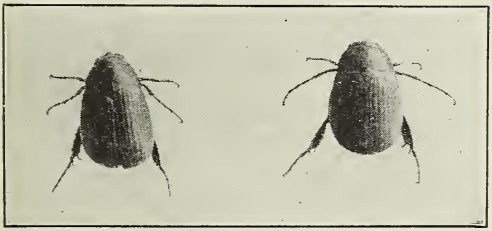

FIGURE 6.—Adults of the Asiatic garden beetle. ×2

Newly hatched larvae feed on tender young roots and disintegrated vegetable matter. Normally about 75 per cent of the larvae complete their growth before the advent of winter, the remainder, for the most part, reaching the second instar, though occasionally even larvae in the first instar have been found late in the fall when further change would be prevented by low temperatures. However, as first-instar grubs have never been found in the spring.

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[3] June 25, 1929, June 23, 1930, and June 27, 1931.

it would appear that they are unable to survive the winter. Feeding by the larvae continues until freezing weather begins. About the middle of October they migrate downward in the ground to from 8 to 17 inches below the surface, where they cease feeding and pass into a dormant condition which continues through the winter.

In the spring, usually about the middle of April, the larvae return to the top 5 inches of soil and resume feeding on plant roots. This continues until about the middle of June. During this time all second-instar larvae which had passed the winter in that stage complete their growth and become third-instar larvae.[4] Near the close of the third instar each larva constructs an earthern cell, from 1½ to 4 inches below the surface, in which, after spending about five days in a comparatively inactive prepupal state, it molts and becomes a pupa.

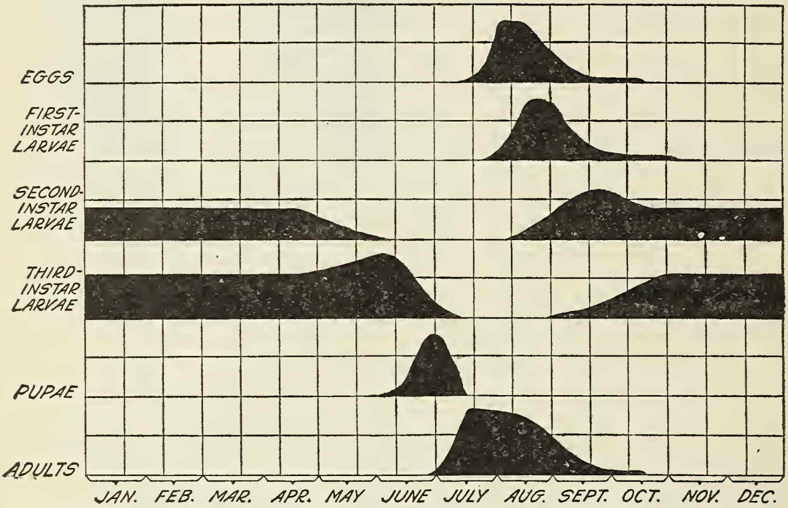

FIGURE 7.—Approximate seasonal occurrence of the stages of the Asiatic garden beetle in the field

Pupae occur normally during the last half of June and the first half of July, the actual field records extending from June 14 to July 16. (Fig. 7.) The pupal stage is short, the observed extremes being 8 and 15 days, and the average 10 days. The adult appears when, at the end of this period, the pupal skin splits, but it remains for a few days within the pupal cell, during which time it becomes hardened and its color changes from a white tint to chestnut brown. It then burrows upward to the surface and emerges from the soil as the fully formed adult beetle.

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[4] The length of the three larval instars in confinement shows considerable variation. The larvae under observation were kept during the summer and fall in an insectary under essentially outdoor temperatures, but in the winter indoors at a temperature of approximately 70° F. Under these conditions the length of the different instars was as follows: First instar (173 individuals), 9 to 50 days—average, 27 days; second instar (131 individuals), 13 to 79 days—average, 30 days; third instar (53 individuals), 29 to 131 days—average, 65 days. Such larvae reached the pupal stage and became adults at various times throughout the winter, a result which is in agreement with observations made in greenhouses into which in the fall larvae had been carried at times along with soil. They emerged as adults during the following winter. Under natural conditions, however, larvae do not complete their development and transform into pupae until about the middle of June.

HABITS OF THE ADULT

The adults of the Asiatic garden beetle fly and feed only at night, hiding during the day in the moist ground at the bases of their food plants or in near-by grassland. On cool nights throughout the summer, when the temperature remains below 70° F., some of the beetles emerge from the ground, but confine their feeding at such times to grass, weeds, and other low-growing herbage. Apart from the slight feeding which they do on such occasions, they are quite sluggish. As a result, during the early part of the season, when the nights are still cool, the beetles feed almost exclusively on plants growing in the vicinity of the place where they emerged, but the damage done at this time is never extensive enough to attract the attention of the casual observer. On warm nights, however, when the temperature is above 70°, the beetles are very active and often swarm about in great numbers. On such occasions[5] they invade ornamental gardens where their favorite food plants are to be found and often infest these so heavily that in a single night whole rows of plants may be completely defoliated. Usually they do not become injuriously abundant in such gardens before the middle of July. They continue to feed ravenously during August, and at this time, in addition to the attack on their favored host plants, they often spread to beds of low-growing nursery seedlings. Here they have been observed to feed on small pine, hemlock, yew, and barberry plants, but extensive defoliation has been noted only in the case of barberry.

There are only a few nights in a season when the beetles fly actively all night. Generally it has become sufficiently cool by midnight so that all flying ceases, and, in the vicinity of New York City, about half of the summer nights are too cool for any pronounced flights. During July and August there were 26 nights in 1929, 17 nights in 1930, and 35 nights in 1931 when the mean temperature between 8 p. m. and 11 p. m. (eastern standard time) was 70° F. or above, and on these nights the beetles were found flying actively.

The beetles are attracted to artificial lights and have often been observed to gather in large numbers on electric-light poles and the window screens of lighted houses. This fact aids in studying the distribution and abundance of the insect (*6*). Observation in the presence of light bulbs of 500 to 1,500 watts power has shown that the beetles will fly distances of at least 200 to 500 yards when attracted to the light. Flights equally long have been observed when the beetles fly away from the vicinity of a bright light as the night temperature falls to 70° F. or below. It is also clear that at times the insect will fly high above the ground, especially in cities where electric lights are extensively used, as Felt (*4*) has reported finding this insect on the roof of a 30-story building in New York City and several of them on the roof of a 13-story building in Mount Vernon, N. Y.

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[5] In 1929 extreme warm weather occurred, July 7 to 10, so that large numbers of beetles flew into ornamental gardens, but in 1930 and 1931 such flights did not occur until July 15.

While large numbers of the Asiatic garden beetle are frequently found together in one spot, it can not be appropriately termed a gregarious insect. Such local aggregations are evidently conditioned by some more or less adventitious external conditions. On nights when the beetles are very active no indication was found of any general movement in a uniform direction, but the beetles appear to swarm about quite at random, moving in various directions. Apparently, the presence of a few beetles feeding on a plant does not attract more beetles to this plant. Beetles collect together on a single preferred food plant only in places where the infestation is heavy, and in that event they tend to be fairly uniformly distributed on all similar plants growing in the immediate vicinity. During the daytime from 50 to 200 adults may be found in the soil at the base of such favored food plants as aster, chrysanthemum, dahlia, and rose, and here also they are apparently evenly distributed in the soil.

Beetles may also be found during the day more or less evenly scattered in the topsoil of grassy fields, lawns, and weedy places, and it is in these places that the females deposit most of their eggs. The choice of the exact spot for oviposition seems to be dependent largely on the proximity of preferred host plants, the type of cover, and the texture and moisture content of the soil. The beetles will apparently travel rather long distances to find these conditions, for it has been often observed that many, after collecting around lights at night, instead of going into the ground near the light, dart out into the darkness, and their course has been watched in some cases for at least 200 yards. Since beetles do scatter in this way, it is believed that lights have but little influence on the choice of breeding grounds. This idea is strengthened by the fact that in several places where conditions were apparently equally favorable, diggings have tended to show that grubs were actually more abundant some distance from lights than directly beneath them.

HABITS OF THE LARVA

The larvae are not uniformly distributed over any large area. They show a decided preference for grasslands, but they are often found feeding on the roots of plants in cultivated areas. Although they prefer moist but not swampy ground, they have been found at times in very dry gravelly soil, feeding on the roots of Canada bluegrass (*Poa compressa* L.), in numbers ranging from 10 to 30 to the square foot. The larvae found in these dry soils develop more slowly than those found near by in soils of average moisture content. The larvae will feed on the roots of practically all plants, but they appear to relish certain species more than others. For instance, when orange hawkweed (*Hieracium aurantiacum* L.) is present, it appears to have a strong attraction. Thus, in one rather lightly infested lawn, from 25 to more than 100 larvae per square foot were found beneath patches of this weed, whereas elsewhere in the same lawn they ranged from none to not more than 10 per square foot. In areas of quite heavy infestation the number of larvae found in lawns and other grasslands has been as high as 345 per square foot. In flower or vegetable gardens there have been found at times as high as 30 larvae to the square foot.

In sod land the larvae feed within the top 5 inches of soil, the majority quite near the surface. During warm weather it is only rarely that they occur in such places below 5 inches. In gardens and other cultivated areas, where the soil is rather loose, however, they tend to dig somewhat deeper into the soil.

The lateral migration of the larvae in the soil has been studied since 1927. Cages, each 40 to 50 inches long, 12 inches wide, and 12 inches deep, provided with screen bottom and top, were sunk into the ground in August and allowed to remain undisturbed until the following spring. Each of these cages had a good sod of growing grass and wheat to furnish food for the larvae. From 100 to 500 larvae were placed at one end of each cage. When examined in the spring, the number which survived varied from 20 to 55 per cent in the different cages. These were found to have become fairly uniformly distributed through all the cages to a distance of 36 inches from the end in which they had been placed. Beyond this distance only a few were present at irregular intervals up to 45 inches. In other cages of the same kind, in which no food was grown, it was found that, after as short an interval as 10 days, the larvae had become rather uniformly distributed within a distance of from 24 to 28 inches from the end in which they had been placed and that some individuals had wandered as far as 34 inches.

It is naturally more difficult to trace larval movement in the field than under experimental conditions. In the spring of 1930, and again in 1931, it was found in a vegetable garden examined near East Williston, N. Y., that larvae were far more abundant in the peripheral 10 or 12 feet than elsewhere in the garden. This garden was surrounded by a heavily infested tract of sod land from which the larvae had evidently migrated into the adjoining portions of the garden. In the latter the larvae were found congregated either along the vegetable rows, which were about 12 inches apart, or about the hills of corn, which were about 30 inches apart. At the same place there was a strawberry bed so heavily infested that the plants in some parts had been killed by the feeding of the grubs. These spots were quite bare, and digging showed that the grubs had left these areas and congregated about the plants that were still alive. The distance traversed in this instance was estimated to be from 3 to 6 feet.

FOOD PLANTS AND FEEDING OF ADULTS

The Asiatic garden beetle has been observed to feed upon more than 100 species of plants. The foliage of ailanthus, aster (fig. 8), barberry (young shoots), chrysanthemum, dahlia, devils-walkingstick, phlox, rose, and sumac forms their favorite food, so that these plants during seasons of heavy infestation are often completely defoliated.

When host plants are in bloom during the adult-beetle season, the blossoms as well as the foliage are often attacked and sometimes completely destroyed. The petals of the flowers are eaten so that the blooms are of no value. (Fig. 9.) There have been several cases where beds of asters have been attacked to such an extent that scarcely a blossom was left. In one large garden at Jericho, N. Y., in 1931, 50 per cent of the dahlia blossoms were ruined.

The severe drought in 1929 and 1930 held the insect in check temporarily, but in 1931 there was a remarkable increase in its abundance. Extensive injury may, therefore, be expected in the metropolitan New York area unless unfavorable weather conditions check the increase of the insect.

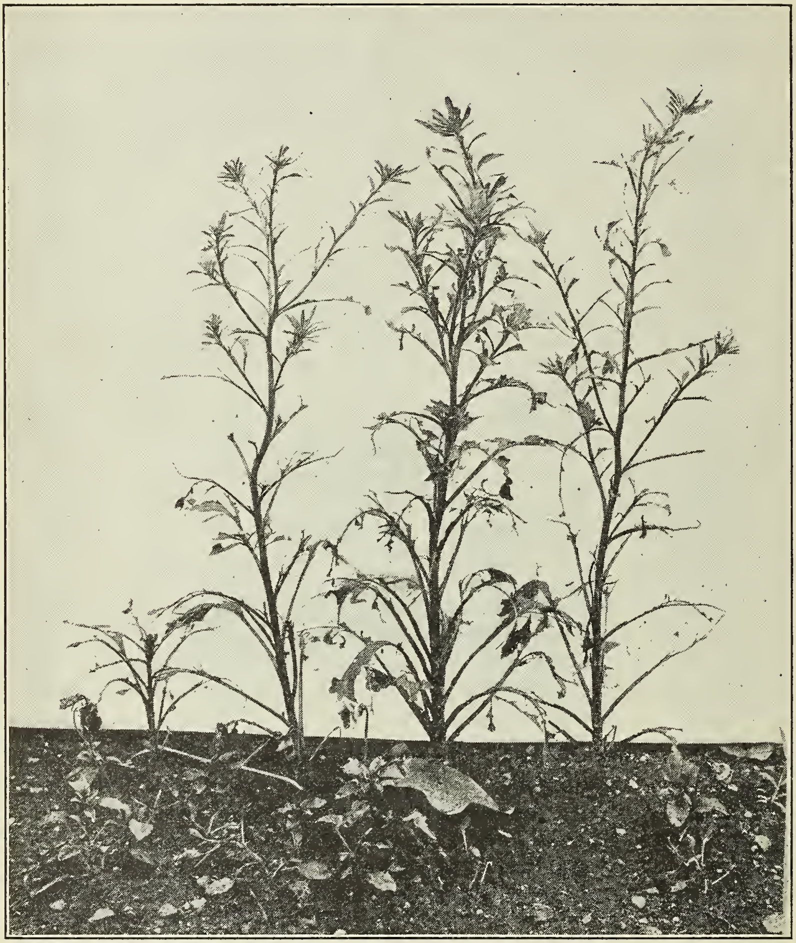

FIGURE 8.—Characteristic injury to asters caused by the Asiatic garden beetle

The following list[6] of food plants gives only those plants upon which the beetles have been observed to feed extensively in the heavily infested areas. Plants most vigorously attacked are marked with an asterisk. In all cases the foliage is eaten, unless otherwise indicated.

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[6] Wherever possible, the scientific names used are those given in Standardized Plant Names (*1*).

LIST OF FOOD PLANTS

SHRUBS AND PLANTS

Acer dasycarpum, silver maple.
Acer negundo, boxelder*.
Aesculus hippocastanum, horsechestnut.
Ailanthus glandulosa, ailanthus*.
Aralia spinosa, devils-walkingstick*.
Berberis thunbergi, Japanese barberry.
Buddleia davidi, orange-eye butterflybush*.
Catalpa spp., catalpa.
Hibiscus syriacus, shrub-althea.
Hydrangea spp., hydrangea.
Ligustrum ovalifolium, California privet.
Magnolia spp., magnolia.
Philadelphus coronarius, sweet mockorange.
Prunus serrulata, oriental cherry.

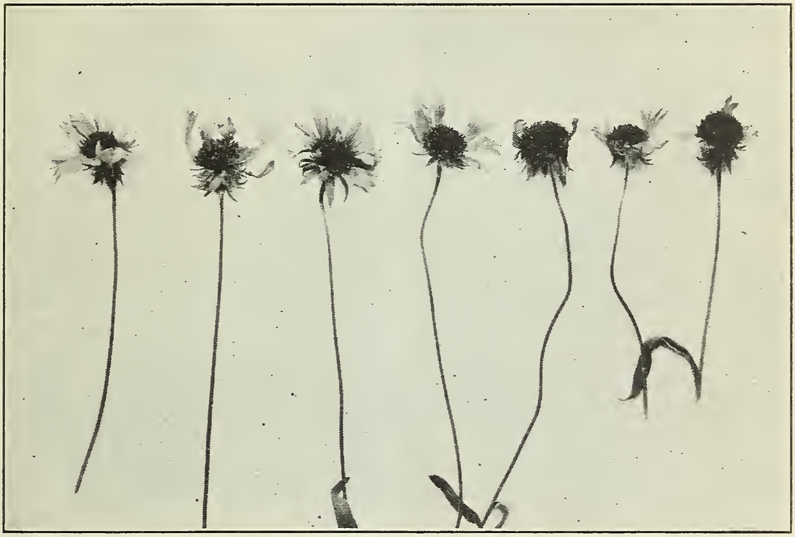

FIGURE 9.—Characteristic injury to flowers of gaillardia caused by the Asiatic garden beetle

Rhus spp., sumac*.
Robinia pseudoacacia, common locust.
Rosa spp., rose*.
Salix spp., willow.
Viburnum spp., viburnum.

FRUITS

Amygdalus persica, peach*.
Fragaria spp., strawberry.
Morus spp., mulberry.
Prunus spp., cherry*, plum.
Ribes spp., currant.
Rubus spp., blackberry*.
Vaccinium spp., blueberry.

VEGETABLES

Capsicum spp., redpepper.
Daucus carota, common carrot*.
Ipomoea batatas, sweetpotato.
Pastinaca sativa, parsnip.
Raphanus sativus, radish.
Rheum rhaponticum, common rhubarb.

PERENNIAL AND ANNUAL FLOWERS

Ageratum spp., ageratum.
Aster spp.. aster* (foliage and flowers).
Begonia spp., begonia.
Chrysanthemum spp., chrysanthemum*.
Dahlia spp., dahlia* (foliage and flowers).
Delphinium spp., larkspur* (foliage and flowers).
Digitalis purpurea, common foxglove.
Gaillardia aristata, common perennial gaillardia* (foliage and flowers).
Gerbera jamesoni, flame-ray gerbera* (foliage and flowers).
Helianthus annuus, common sunflower* (foliage and flowers).
Helichrysum bracteatum. strawflower* (foliage and flowers).
Ipomoea purpurea, common morning-glory.
Pelargonium domesticum, Lady Washington geranium.
Phlox spp., phlox* (foliage and flowers).
Rudbeckia laciniata (horticultural variety), goldenglow (foliage and flowers).
Salvia splendens, scarlet sage.
Solidago spp.. goldenrod (foliage and flowers).
Zinnia spp., zinnia.

WEEDS

Ambrosia trifida, great ragweed*.
Arctium spp., burdock.
Bidens frondosa, beggar-ticks.
Plantago spp., plantain.
Polygonum pensylvanicum, smartweed.
Xanthium spp., cocklebur.

INJURY FROM LARVAL FEEDING

Larval infestation is not uniform over any large area. The places where grass has been killed range in size from a few square inches to more than an acre. Injury to sod land does not usually occur until there are at least 20 or more larvae to the square foot. In some cases lawn grass partially recovers after the Asiatic garden beetle grub season because the roots are not entirely eaten, but in cases where the infestation is heavy the lawn is often irretrievably ruined. Even a few consecutive years of only moderate grub infestation in a lawn will weaken and eventually destroy the better lawn grasses, and, by giving the weeds a chance to develop and spread, will ultimately ruin the lawn.

In localities of dense infestation the grubs during the past two years have been found to invade flower and vegetable gardens which had been under cultivation for several years. Four to five grubs feeding on the roots are often sufficient to kill a plant, and noticeable injury has occurred when only two or three grubs were present. During the 1930 and 1931 seasons grub injury has been observed in flower gardens on begonia and columbine, in vegetable gardens on beet, corn, onion, and strawberry plants (fig. 10), and in nurseries on yew seedlings. The amount of injury to strawberry beds varied from the killing of a few plants to as many as 90 per cent. Noticeable injury in cultivated areas has been confined to young plants in all cases except columbine and strawberry plants.

DISPERSION

While the spread of the Asiatic garden beetle has not been rapid, there has been a steady enlarging of the older infested areas as well as the discovery of a number of new infestations at a considerable distance from the earlier, more densely infested areas. As a result of the natural distribution, the beetles are now abundant over a large suburban area around New York City.

Mechanical agencies are also of considerable importance in the spread of the insect. The greatest danger lies in the shipment of plants bearing about their roots a ball of earth, sod, or soil which might contain larvae or adult beetles. The spread of the insect to several outlying points, 40 to 90 miles from any known dense infestation (fig. 1), can be explained only as caused by agencies of this nature. Although the beetles fly into automobiles, observations tend to show that this means of distribution is not very important.

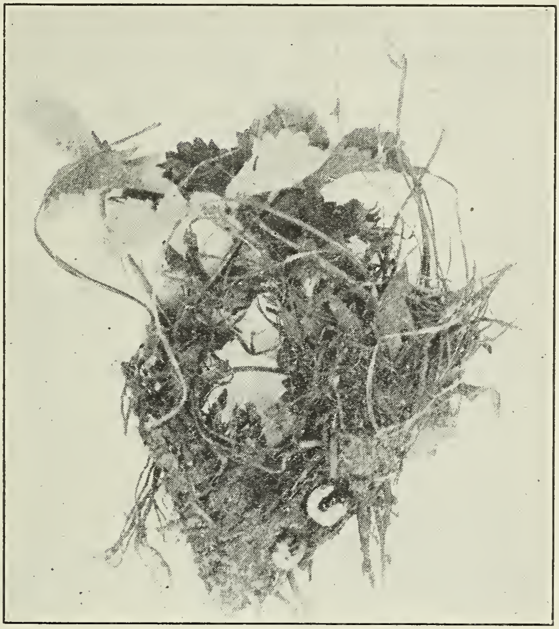

FIGURE 10.—Characteristic injury to strawberry roots caused by the feeding of Asiatic garden beetle grubs

CONTROL

NATURAL CONTROL

During the summer of 1929, in connection with the search for parasites of the Japanese beetle (*Popillia japonica* Newm.) in Japan, studies were made of the natural enemies of the Asiatic garden beetle. In the fall of 1929 a large shipment of the cocoons of the wasplike parasite *Tiphia asericae* Allen and Jaynes was sent to the Japanese beetle laboratory at Moorestown, N. J.; the following summer colonies of adult parasites reared from these cocoons were released in infested areas on Long Island, N. Y., and near Philadelphia, Pa.

This parasite deposits its eggs on the larvae of the Asiatic garden beetle, which are subsequently destroyed by the feeding of the parasite. No recoveries of this parasite have been made as yet, and more time is necessary before the exact status of the species can be determined.

ARTIFICIAL CONTROL

CONTROL OF LARVAE

The application of lead arsenate to lawns in New York State has shown that the same treatment that is used for the Japanese beetle (*Popillia japonica* Newm.) and Asiatic beetle (*Anomala orientalis* Waterh.) will protect lawns from grubs of the Asiatic garden beetle. Complete details of this treatment are given by Fleming and Osburn (*4a*). As the larvae of this species feed deeper in the ground than those of the Asiatic or Japanese beetles, it appears from observations that better results will be secured when the poison is mixed thoroughly with the top 3 inches of soil. The lead arsenate may be applied to the ground at any time of the year when the ground is not frozen, but it is most effective when in the ground before the eggs hatch.

At the present time it is recommended that no treatment be applied to flower gardens, vegetable gardens, or to grass upon which stock may feed. It is advised that the treatment be limited to lawns, golf courses, and other grass plots where injury is occurring.

Treatment of new lawns.—New lawns can be made practically immune to injury by larvae for 6 to 10 years by mixing powdered lead arsenate with the soil prior to sowing the seed. In this case the lead arsenate is applied at the rate of 35 pounds to 1,000 square feet of surface and mixed thoroughly by means of a disk or cultivated to a depth of 3 to 4 inches. The lawn is then seeded and cared for in the customary manner.

Treatment of old lawns to control the larvae.—The larvae can be controlled on established lawns by applying lead arsenate to the surface at the rate of 15 pounds to 1,000 square feet. It is largely a matter of choice whether the chemical is applied in a dry state, mixed with a suitable carrier, or in water. In case it is more convenient to apply the chemical in the dry form, it is recommended that the lead arsenate be mixed thoroughly with a bushel of sifted soil or other carrier to facilitate the proper distribution.

Where it is more convenient to apply the chemical in liquid form, a power sprayer which has a pressure of 250 to 300 pounds, and is equipped with a Worthley nozzle and a baffle, should be used. In such cases a mixture containing 1 pound of lead arsenate to 2 gallons of water is recommended. The use of a relatively insoluble material such as lead arsenate, with water, especially in such dense concentrations, necessitates sufficient constant agitation to keep the material in suspension. After the spray has been applied and before it has had time to dry, the lawn should be watered sufficiently to wash the material off the grass and into the ground.

CONTROL OF ADULTS

At the present time there is no known method of completely protecting plants in cases of heavy beetle infestation, since a satisfactory repellent has not yet been developed. The beetles feed readily on poisoned foliage, and in cases of only moderate infestation, where there is little likelihood of continued reinfestation, enough may be killed to give satisfactory protection to most host plants.

There is some indication also that, if spraying recommendations are followed carefully by all the residents of a heavily infested neighborhood, sufficient beetles may be killed to cause a decrease in numbers the following year.

Ornamental shrubs, trees, and perennials marked with an asterisk in the list of food plants should be sprayed with 6 pounds of coated lead arsenate to 50 gallons of water, or 3 pounds of powdered lead arsenate and 2 pounds of flour in 50 gallons of water, not later than July 10 in a normal season. Where only a small amount of spray is needed, it may be used at the following strength: 10 ounces of coated lead arsenate to 5 gallons of water or 5 ounces of powdered lead arsenate and 5 ounces of flour to 5 gallons of water.

VALUE OF LIGHT TRAPS

Experimental work (*8*) carried on for several years has shown that great numbers of beetles may be captured in properly constructed light traps. The most efficient trap tested to date consists of a funnel 4 feet in diameter at the top, 1½ inches at the bottom, and 3½ feet deep, with a can beneath the funnel containing water covered by a kerosene film. A 500-watt electric daylight bulb is suspended above the trap. Considerable additional work is necessary to determine the value of these traps as a control measure, and their use is not recommended at the present time.

SUMMARY

The Asiatic garden beetle, an insect native to Asia, became established in the eastern part of the United States some time prior to 1921. Since that time it has increased in numbers and spread until at the end of the summer of 1931 it was found to occur at a number of points extending from Virginia to the northern part of Connecticut. It is chiefly in the metropolitan area of New York City that injury has occurred to lawns and ornamental garden plants.

The Asiatic garden beetle completes its life cycle in one year. It spends about 10 months in the ground as a larva feeding on plant roots. Adults are present from late June to October and feed during warm nights on foliage and blossoms. The eggs, which are deposited in the ground, hatch into larvae, and these, after passing through three instars and a pupal stage, become adults in the following year.

In lawns where the beetle infestation is dense the larvae may be controlled by applying 35 pounds of lead arsenate to 1,000 square feet of lawn when the lawn is being built, and thoroughly cultivating to a depth of 3 to 4 inches.

In the case of old lawns protection can be secured by top-dressing with 15 pounds of lead arsenate to 1,000 square feet of lawn.

The plants which are generally defoliated should be sprayed with 6 pounds of coated lead arsenate to 50 gallons of water, or 3 pounds of lead arsenate and 2 pounds of wheat flour to 50 gallons of water. This spray should be applied not later than July 10.

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